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Academy Needs Bigger Role in Antarctic Studies, Environment Protection

18650220 Moscow PRAVDA in Russian 11 Jul 89 p 3

[Article by N. Laverov, vice-president of the USSR Academy of Sciences; V. Kotlyakov, corresponding member of the academy, chairman of the Interagency Commission for the Study of Antarctica]

[Excerpt] At one time, the Soviet Antarctic Expedition (SAE) and its authorized staff were partially transferred from the jurisdiction of the Academy of Sciences to that of the State Committee on Hydrometeorology (Goskomgidromet).

It was from that moment that a gradual process of 'attrition' of science in the SAE began, because it was impossible to support research on a sufficiently broad scale by the efforts of the agency's science alone.

The presidium of the USSR Academy of Sciences is taking appropriate action to rectify the existing situation. A decision has been prepared which calls for the role of academy science in the study of Antarctica to be enhanced. The Interagency Commission for the Study of Antarctica, which operates under the academy's presidium, has been instructed to prepare proposals regarding the drafting of an all-academy program, "Antarctica", for the period 1990-1995 and beyond.

For the overall situation that exists in SAE to be changed, coordinated actions by all agencies which are pursuing undertakings in Antarctica, particularly USSR Goskomgidromet, will be necessary, of course. It is Goskomgidromet which is generally responsible for the Antarctic expedition and must take vigorous action to improve ecological conditions in area where Soviet stations are operating. The Academy of Sciences is ready to render support in the form of consultations, theoretical developments and expert evaluations.

UDC 550.348+550.348.098.64

Intensity and Frequency of Recurrence of Strongest Earthquakes

[Article by N. D. Zhalkovskiy, Geology and Geophysics Institute, Siberian Department, USSR Academy of Sciences, Novosibirsk]

[Abstract] The distributions of earthquakes by intensity and frequency of recurrence are examined for individual seismic zones and for the Earth as a whole. Three groups of data are examined: earthquakes for the entire Earth with a focal depth less than 50 km with a magnitude greater than 7 for 1921-1977; earthquakes for the Kurile-Kamchatka zone with the same focal depth for 1956-1975 with a magnitude greater than 6; crustal earthquakes for Central Asia and Kazakhstan for 1951-1974 with a magnitude greater than 5.0. An analysis of these data indicates that for both the Earth as a whole and for its individual seismic zones it cannot be said that the strongest earthquakes detected within their areas are the maximal possible. There is reason to believe that in each of these regions there will be earthquakes which will be far stronger than registered up to the present time. The difference between the strongest observed and the strongest possible earthquakes for most individual seismic zones will be considerably greater than for the Earth as a whole. Prevailing concepts concerning maximal earthquakes do not correspond to reality. Figures 3; references 18: 11 Russian, 7 Western.

UDC 550.34

Effect of Sharp Decreases in Density of Ionospheric Sporadic E$_s$ Layer as Earthquake Precursor

[Article by O. A. Alimov, M. B. Gokhberg, Ye. V. Liperovskaya, I __. Gufeld, V. A. Liperovskiy and L. N. Rubtsov, Earth Physics Institute imeni O. Yu. Shmidt, USSR Academy of Sciences, Moscow; Astrophysics Institute, Tajik Academy of Sciences, Dushanbe]

[Abstract] A new convenient parameter is proposed for characterizing the fine structure of the diurnal variation of the critical frequency $f_b E_s$. This parameter is quite sensitive to the electromagnetic processes transpiring in a zone of earthquake preparation. A study was made of the behavior of sporadic E$_s$ layers only for nighttime conditions for 4-5 days before and 2 days after a number of quite strong earthquakes close to the observation station. The new parameter is called the "cutoff" in the diurnal variation of $f_b E_s$. The "cutoff" refers to a decrease in $f_b E_s$ by not less than $\Delta f = 0.8$ MHz in 15 minutes. Such a decrease evidently corresponds to bursts of seismoelectric activity, series of brief impulses of the electromagnetic field, heating of electrons and rapid diffusion of the sporadic layer. Two groups of nights were examined: 1) 2 days before earthquakes and background nights. An example is cited. Seven earthquakes with a magnitude greater than 4.5 were examined. All were accompanied by an increase in the number of "cutoffs" 2 days prior to the tremor. The dependence between the presence of the seismoionospheric effect and magnitude and distance from the epicenter is examined. No effect in E$_s$ was discovered for earthquakes with a magnitude less than 4.0 and it is difficult to use the "cutoff" test in the case of a very high ionization density associated with increased meteor activity. Figures 3; references: 6 Russian.

Soviet, U.S. Scientists' Work on the New Earthquake Forecasting Methods

[Interview by Kim Smirnov]

[Excerpt] A report by academician Vladimir Isaakovich Keylis-Borok on prospects for forecasting earthquakes will be discussed at the next meeting of the presidium of the USSR Academy of Sciences. An IZVESTIYA correspondent met with him.

"Forecasting methods which scientists of the USSR and USA are jointly developing are based on observations of general phenomena which precede unexpected changes also in geological faults and in many other systems which are chaotic and potentially unstable (chemical, biological and even socioeconomic) [said V. I. Keylis-Borok]. These methods also reflect new achievements of contemporary geology, primarily findings in regard to interaction of solid and liquid components of the earth's crust.

"But it must be stressed that our methods are in the trial stage and are still quite imperfect. The main part of the work has not yet been done."

"When he appeared this summer in Strasbourg, M. S. Gorbachev invited the scientists of the world to participate in the work of the International Institute for the Theory and Forecasting of Earthquakes Mathematical Geophysics which has been established in the USSR. What needs gave rise to this institute, what will it be like?"

"The algorithms which we developed jointly with the U.S. scientists are successfully being tested in various seismic regions.

"This is part of a unified global experiment, in which our method of medium-range forecasting of earthquakes is undergoing practical testing. Thirty scientists from 12 countries, including the United States, Italy, France, India, Pakistan, Canada, Peru and others, are participating in these operations.

"It is to strengthen the cooperation of scientists from various countries in this area that the USSR Academy of Sciences is organizing the International Institute for the Theory and Forecasting of Earthquakes and Mathematical Geophysics.

"For a long time efforts in earthquake forecasting have been directed toward expanding the system of observations. The California earthquake has shown us graphically how inadequate this is. It occurred in the middle of one of the most powerful observation networks in the world, with thousands of gauges, telemetry and complete computerization. And the predictions obtained by traditional methods were completely uncertain: there is a 30 percent chance of an earthquake within 20 years; there is a 50 percent chance of a more powerful one within 50 years....

"The new Soviet-American methodology yields much more definite results: roughly speaking, there is an 80 percent chance of an earthquake within 5 years."

Creation of Geodetic Laboratory for Earthquake Forecasting Urged

18650222 Baku BAKINSKIY RABOCHIY in Russian 10 Dec 89 p 3

[Article by R. Eminov, Candidate of Technical Sciences, senior instructor of the chair "Engineering Geodesy" of the Azerbaydzhan Institute of Civil Engineering]

[Excerpt] A certain project which will make it possible to outline ways of making research in the field of earthquake forecasting more effective is in progress in the Azerbaydzhan Institute of Civil Engineering's chair of engineering geodesy. It is still too early to say that we have flawless methods for forecasting geomechanical and geodynamic processes, of course, but our studies have indicated that a leading place should be reserved for the geodetic method in such forecasting, since this method allows the epicenter, intensity and possible time of a seismic manifestation to be approximately determined several years in advance. Employment in combination of all of the methods which are now in existence for recording seismic manifestations could serve as a guarantee of reliable forecasting of earthquakes.

A special scientific research laboratory is needed, in our opinion. Groups of geodesists, geophysicists, geologists, hydrogeochemists, geographers and seismologists should be enlisted in the work of this laboratory. Also needed is an optimal network of observation stations 'referred' to posts of a geodynamic survey area already in existence and equipped with improved devices and instruments, with broad utilization of the capabilities of computers.

Such a scientific research laboratory could be created jointly by the Azerbaydzhan Academy of Sciences' Institute of Geology and the republic Council of Ministers' Azerbaydzhan Aerial Geodesy Association.

As for introduction of results of research in the field of Earth physics, they can be used not only in forecasting earthquakes, landslide phenomena, volcanic processes or orogeny, rock falls and floodings of territories but also in studying the character of present-day vertical and horizontal movements of the earth's crust and surface. The latter have been arousing much interest among designers and builders with various specialties who have suffered on more than one occasion from ill-studied mechanics of the earth's surface and processes which take place in the earth's interior.

Work on Electromagnetic Methods for Forecasting Earthquakes

18650223 Minsk SOVETSKAYA BELORUSSIYA in Russian 2 Sep 89 p 3

[Article by V. Ovcharenko]

[Abstract] In a lengthy interview, Candidate of Technical Sciences Ivan Sergeyevich Ledovskoy, a docent, discusses earthquake forecasting research which he and a number of other Minsk scientists have been conducting, and problems with introducing results of their work.

With regard to the significance of this project, Ledovskoy reports that about 30 discoveries in the field of earthquake forecasting were registered as of 1 January 1989. (The titles, registration numbers and authors of four discoveries are mentioned in particular. They are No 129, "The Phenomenon of Change of the Chemical Composition of Underground Waters in an Earthquake" [G. A. Mavlyanov et al.]; No 216, "The Phenomenon of Change of Effective Specific Electrical Resistance of Rock Masses before Local Earthquakes" [O. M. Barsukov]; No 273, "The Phenomenon of Totally Manifested Rapidly-Occurring Pulsation Changes in the Hydrosphere" [the Vartanyan-Kulikov Hydrologic Effect]; and No 301, "Regularities Governing Connections (Energy) between Tectonic Crustal Continental Earthquakes and the Sizes and Types of Seismogenic Geological Structures [I. Ye. Gubin].) However, most of the work in this field has been theoretical in nature, and many discoveries still have not been put into practice because this entails many difficulties: extensive preparation of experiments, prolonged observations of high precision, costly and highly specialized equipment, and coordination of the work of scientists affiliated with different agencies, for example. Earthquake precursor phenomena are so numerous and diverse that forecasters have been unable, with available funds and resources, to gather sufficient information on many of them. Forecasts consequently are only 30 to 40 percent reliable at present. Ledovskoy's group has focused its attention on electromagnetic precursor phenomena which it considers to be among the most informative for forecasting purposes.

In connection with work on forecasting the reliability of radioelectronic systems, determining their quality and

studying processes of their degradation, the Minsk scientists hypothesized the existence of common mechanisms which underlie the development of noise processes in various objects, it is recalled. It was discovered that fluctuations of earth currents and liberation of gases increase in the earth's crust in connection with deformation of rocks which precedes an earthquake. Powerful electric fields form in the earth's interior and on its surface as a result of these and other mechanisms. Interaction between gas emissions and the electric field of the earth's crust gives rise to local charged 'clouds' which rise into the ionosphere and interact with it. Changes in permittivity, permeability and conductivity, ionized formations and other atmospheric phenomena occur in the epicentral region of a future earthquake as a result. The atmospheric medium can be 'inspected' by transmitting electromagnetic radiation over a certain distance and recording changes in the parameters of this radiation. The process of an earthquake's preparation and development can be judged on the basis of these changes.

On the screen of a radar set, ionized formations moving toward the ionosphere over the area where an earthquake is developing appear periodically, in the form of 'snow' and blips, Ledovskoy relates. The direction from which they are coming can be determined by taking a bearing with several radar sets. Not only the place of occurrence of an impending earthquake but its time of occurrence and intensity can be forecast by methods which the Minsk scientists have developed, it is claimed. Ledovskoy mentions that his group has studied mechanisms of electromagnetic precursor phenomena in collaboration with associates of the USSR Academy of Sciences' Institute of Earth Physics who are under the direction of I. L. Gufeld. Earthquake forecasting

methods which Ledovskoy and his colleagues have proposed have been tested and endorsed by personnel of this institute.

Ledovskoy goes on to report that his group is in the process of gathering information which can be used for forecasting earthquakes by the new methods. During the second half of 1988, members of the group went to the Caucasus to observe abnormal electromagnetic phenomena occuring in areas under study and in the operation of radio equipment, for example. In publicizing results of their work, the Minsk scientists have been handicapped by the attitude of officials who appear to be biased in favor of forecasting methods that are obsolete and relatively ineffective, in Ledovskoy's opinion. Although he and his associates have received 11 certificates of invention and positive decisions on applications for certification of their innovations, methods which the group has proposed have not yet been published in the BULLETIN OF INVENTIONS IN THE USSR, and the State Committee on Inventions and Discoveries still has not acted favorably on a discovery which the Minsk scientists made in June of 1986 and submitted for registration. This discovery is entitled "The Phenomenon of Modulation of Electromagnetic Radiation during the Preparation of Local Earthquakes." Earthquake-forecasting methods which have been developed on the basis of the discovery are said to be versatile, highly reliable and comparatively inexpensive, since they employ simple radio devices. Parameters of electromagnetic radiation can be measured in fractions of a second, it is claimed. Ledovskoy notes that the methods can be employed in a wide range of frequencies and in any kind of local or weather conditions. They also permit remote forecasting of earthquakes with the aid of aerospace and terrestrial radar systems.

UDC 551.524.7:551.521.7

Retrieval of Stratospheric Temperature Profile From Remote Measurements of Ascending Radiation in Microwave Range

[Article by Ye. N. Kadygrov, V. S. Kurakin, candidate of physical and mathematical sciences, B. I. Sakhnev and A. N. Shaposhnikov, Central Aerological Observatory]

[Abstract] Since stratospheric temperature is one of the most important parameters used in describing various atmospheric dynamic and heat exchange processes, satellite instruments operating in the microwave range have been introduced for determining this parameter. Much work along these lines has already been done in the Western countries. Some of the instruments and procedures used for this purpose are reviewed. The focus of this study is an evaluation of the correctness of choice of working frequencies, number of measurement channels, transmission bands and other radiometer parameters. In the computations the temperature profiles were retrieved by the regression method. Regression methods are advantgeous for the mass processing of satellite data due to their algorithmic simplicity, resulting in a reduction in the required computer time. The regression method is described in detail. Experimental (radiosonde) and computed data are compared. The use of microwave methods is being held back by a number of technical difficulties which must be resolved, but there is good reason to hope for global collection of data on stratospheric temperature with a vertical resolution 8-9 km and an rms error 1.5-2 K. Figures 3; references 8: 3 Russian, 5 Western.

UDC 551.466.8

Influence of Internal Waves on Characteristics of Microwave Signals Scattered by Sea Surface

[Article by V. V. Bakhanov, A. L. Zuyev, M. N. Marov and Ye. N. Pelinovskiy, Applied Physics Institute, USSR Academy of Sciences]

[Abstract] Much information is available indicating the influence of internal waves (IW) on the characteristics of microwave signals scattered by the sea surface. However, the interpretation of such data and the evaluations of oceanographic parameters obtained on their basis involve a need for constructing adequate theoretical models of microwave scattering at the sea surface in the presence of IW. However, existing theoretical descriptions of the influence of IW on the characteristics of microwave signals in a broad range of wavelengths are not entirely satisfactory. Accordingly, this article gives the method and results of computations of the variability of microwave scattering at the sea surface based on a kinematic model and model of the film mechanism of the effect of IW on surface waves. The influence of change in surface layer turbulence in the presence of IW on wind waves was not examined due to the inadequacy of data on the quantitative characteristics of the field of surface turbulence. The computations were made within the framework of a two-scale model of selective scattering, making it possible to take into account changes in both the spectral density of the Bragg resonance component of waves and the rms slope of larger sea waves. Quantitative evaluations of variations in the strength of microwave signals scattered by the sea surface in the presence of IW were obtained. The presence of two intervals of wavelengths was established where the scattering of microwave signals is most sensitive to the effect of IW at the sea surface; one interval belongs to the centimeter range and the other to the decimeter range. The computed values are consistent with known experimental data. It is shown that the variability of microwave scattering is dependent on the parameters of IW, the wind and sounding conditions. Figure 4; references 23: 17 Russian, 6 Western.

New Vessel 'Konstantinov' With Acoustic Equipment for Ocean Studies

[Article by V. Shchetinin, Leningrad]

[Text] A new vessel, the "Akademik Boris Konstantinov," has been placed at the disposal of the USSR Academy of Sciences' Acoustics Institute. This vessel was built at the "Okean" shipyard in Nikolayev. It is equipped with a thruster, modern equipment for navigation, satellite-aided communications, computers, and unique apparatus for the study of ocean waters by the acoustic method.

The most comfortable conditions for work and recreation during cruises lasting many months have been created on board the vessel. A crew consisting of seamen of the Baltic Marine Shipping Line has been assembled.

The first trial cruise, which the ship made during a passage from the Black Sea to the Baltic Sea, has demonstrated that the vessel is seaworthy and has good maneuverability.

The "Akademik Boris Konstantinov" recently set out for the Atlantic Ocean. It will subsequently conduct expedition work in the Pacific Ocean. It will return to Leningrad next spring.

UDC 551.466:532.591

"Near-Surface" Waves in Upper Quasihomogeneous Layer of Ocean

[Article by V. I. Shrira, Institute of Oceanography imeni P. P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] A mathematical model is suggested for wave processes in the upper quasihomogeneous layer of the ocean, describing the basic properties of these processes and indicating certain direct theoretical and experimental results of their existence. Under typical conditions we must expect the existence of surface waves on a scale of about $5 \cdot 10^1$ m, with periods of about 10^2 s and amplitude of $5 \cdot 10^-$ m/s. They are difficult to observe due to smaller near-surface waves but their interaction with other types of motion may be significant: 3-wave resonant processes can influence the angular spectra of energy-carrying surface wave; these larger waves, by modulating the horizontal velocity on the surface and modulating any level of turbulence and concentration of surfactant films, can create anomalies in gravity-capillary wave spectra. References 9: 7 Russian, 2 Western.

UDC 551.466.8

Resonant Excitation of Internal Waves by Variations of Atmospheric Pressure and Wind Stress

[Article by S. F. Dotsenko, Marine Hydrophysics Institute, Ukrainian Academy of Sciences, Sevastopol]

[Abstract] The resonant generation of internal waves in a continuously stratified rotating ocean by traveling waves of atmospheric pressure and wind stress is studied in a linear formulation. A comparative analysis of the rates of growth of amplitudes of waves resonantly excited by these external disturbances is carried out numerically for the case of a mean distribution of the Vaisala-Brunt frequency in the Caribbean Sea. The analysis and comparison of these data in the case of a really stratified ocean revealed that wind stress plays the main role in the low-frequency region. In the short-wave region fluctuations of atmospheric pressure may be decisive. A numerical analysis confirmed the conclusion drawn earlier for model density stratifications that there is a weakening of the effectiveness of excitation of internal waves by fluctuations of atmospheric pressure with an increase in mode number and that wind stress fluctuations play the decisive role in the generation of the higher modes of internal waves. Figures 2; references 10: 5 Russian, 5 Western.

UDC 551.466.8

Interaction Between Surface and Internal Waves in Arbitrarily Stratified Ocean

[Article by P. B. Rutkevich, A. V. Tur and V. V. Yanovskiy, Space Research Institute, USSR Academy of Sciences]

[Abstract] Although in the general theory of wave processes the interaction between surface and internal waves in the lower orders of the theory of perturbations is usually a special case of interaction below high- and low-frequency waves, the case of medium stratification requires special examination. In the case of a discrete stratification an internal wave is potential, in contrast to the case of a continuously stratified medium in which the internal wave has an eddy character. This article gives a solution of the problem of interaction of potential surface and solenoidal internal waves in a continuously stratified ocean of finite depth under conditions when three-wave processes are forbidden. The multiple scales method is used. The modulation instability of a system of surface and internal waves is examined, as well as second-order decay instabilities. References 16: 14 Russian, 2 Western.

UDC 528.2/.3

Research on Accuracy in Determining Coordinates of Objects at Sea by Hydroacoustic Systems

[Article by V. P. Glumov, docent, candidate of technical sciences, Ye. G. Markaryan, docent, candidate of physical and mathematical sciences, Yu. S. Mikhaylin, docent, candidate of technical sciences, and P. A. Shilkin, docent, candidate of technical sciences, Moscow Order of Lenin Institute of Geodetic, Aerial Photographic and Cartographic Engineers]

[Abstract] Algorithms and methods for determining the coordinates of submersibles and support ships in a local coordinate system (with subsequent transformation to a fixed geocentric system) are described. The algorithms were written with allowance for the technical specifications of modern hydroacoustic navigational-geodetic systems and the possibility of a priori evaluation of the accuracy in determining coordinates. Model experiments demonstrated the good performance of the algorithm and correspondence of the accuracy of the determined coordinates to survey work scales for abyssal regions of the ocean up to 1:50 000. With an increase in depth the accuracy in determining the plane position in actuality does not change but the errors in determining the third coordinate Z (H—depth) increase sharply. Accordingly, a hydroacoustic navigational-geodetic system is not suitable for determining H and a submersible must carry echo sounders for solving this problem. Figures 4; references: 1 Russian.

UDC 551.46

Estimation of Bioluminescent Light Flux in Oceanic Deep Layers

[Article by V. B. Tseytlin and Yu. A. Rudyakov, Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences, Moscow]

[Abstract] In an article by H. Bradner, et al. (DEEP-SEA RES., Vol 34, No 11, pp 1831-1840, 1987) a dependence was found between the bioluminescent light flux F and depth z for the depth range 2000-4300 m. The expression for this dependence is compared with an empirical formula describing the vertical distribution of mesoplankton in the tropical ocean at depths greater than 1 km and the problem is then examined in greater detail. Since most of the unicellular organisms capable of stimulating bioluminescence are peridinal algae and radiolarians, almost completely concentrated in the oceanic surface layer, it can be postulated that at great depths light bursts occur due to mesoplankton, organisms measuring from 0.2 to 20 mm. A new formula is derived on the basis of this research which makes it possible to estimate the light flux of stimulated bioluminescence at great depths on the basis of data on the vertical distribution of the biomass of mesoplankton or with the use of information on biomass distribution in the surface layer. References 10: 4 Russian, 6 Western.

Statistical Research on Interaction Between Energy-Active Regions of North Atlantic and Pacific Oceans

[Article by I. Ye. Chuvashina and V. A. Lyubanskaya, candidates of physical and mathematical sciences, and V. G. Margasova, Main Geophysical Observatory]

[Abstract] The results of research on thermal interaction of different regions of the North Atlantic and Pacific Oceans and interaction among different regions of these oceans are presented. Data are given for eight regions of the North Atlantic as zones of active thermal interaction between the atmosphere and ocean. Two regions in the Pacific Ocean also were selected. The mean monthly temperature of the water surface was used as the characteristic of thermal state of the oceans at points of intersection of a grid 5 x 5° for 12 months during the period 1957-1985, the length of the series being 348 months. It was found that thermal interaction in the North Atlantic occurs in cyclonic and anticyclonic circulations, first of all due to the transport of heat by currents (the period of circulation of waters in the cyclonic gyre is about 2 years and 3-3.5 years; in the anticyclonic gyre it is 4, 5 and 6.5-7 years), and second, due to interaction between the cyclonic and anticyclonic gyres at frequencies with periods 3-4 years. There is a thermal interaction between the North Atlantic and the northern part of the Pacific Ocean at frequencies with periods 2.5-4 and 7-9.5 years. Figures 3; references 13: 12 Russian, 1 Western.

Mean Currents Induced by Low-Frequency Internal Waves

[Article by A. A. Slepyshev and V. S. Shamov, Marine Hydrophysics Institute, Ukrainian Academy of Sciences]

[Abstract] Slightly nonlinear packets of internal waves during their propagation introduce disturbances in the velocity and density fields which have a time scale on the order of the duration of the packet. The corresponding distortions in the velocity and density fields are usually identified with the vertical fine structure generated by a slightly nonlinear packet of internal waves. However, this is correct only with respect to short-period internal waves because the influence of the Earth's rotation is not taken into account. As demonstrated in this article, allowance for the Earth's rotation is of fundamental importance when studying mean currents induced by low-frequency internal waves. The pertinent formulas are derived and their use is illustrated in a model example. The total horizontal flow of mass, integrated in depth, is equal to zero, that is, the induced current precisely compensates the Stokes drift. Figures 5; references 4 Russian.

Evaluation of Influence of Tidal Currents on Wind Wave Height Distribution Function

[Article by V. B. Korobov, candidate of geographical sciences, and I. V. Lavrenov, candidate of physical and mathematical sciences, Northern Territorial Administration for Hydrometeorology; Leningrad Division, State Oceanographic Institute]

[Abstract] An attempt at evaluating the influence of strong currents on the regime functions of the mean heights of waves in the range of small excess probabilities was undertaken on the basis of current concepts concerning the nature of development of wind waves on currents. An approach is proposed for the regionalization of an ocean area on the basis of the predominant contribution of one of two possible mechanisms: generation or transformation of waves on a flow. The procedures for allowance for currents in computations of the mean heights of waves for quasistationary and periodic currents are presented. It is shown that curves of the regime functions, constructed with allowance for currents, are displaced relative to the curves for calm water conditions in the direction of greater wave heights. Estimates of the computed heights of waves, which in ocean areas with strong tides may increase by 14-16%, were obtained. In the case of stationary and quasistationary currents it is sufficient to take synchronous currents into account; in the case of tidal currents, however, the change in current velocity within the limits of the tidal cycle must be taken into account. Figures 2; references 15: 10 Russian, 5 Western.

Manifestations of Internal Waves at Sea Surface in Presence of Surfactant Film

[Article by N. I. Vasilinenko, S. A. Yermakov, A. V. Ivanov, A. R. Panchenko, S. G. Salashin and Yu. I. Troitskaya, Applied Physics Institute, USSR Academy of Sciences, Gorkiy]

[Abstract] There has been only indirect evidence indicative of a film mechanism of the smoothing of surface waves by internal waves (IW) and there have been no

experiments to clarify the formation of bands of smoothing due to the redistribution of surfactants by internal waves. The first highly specialized results of observations of slicks in the field of internal waves in the presence of surfactants of natural origin are described. The observations were made in the summer of 1987 in the coastal zone of the Black Sea from an oceanographic platform situated 0.7 km from the shore where sea depth was about 30 m. IW were registered with a temperature probe and an array of 3 distributed temperature sensors. Data from the latter were used in estimating the direction and velocity of propagation of IW. Surface waves were registered by an optical spectrum analyzer, making it possible to obtain a section of the spectrum of wave slopes with lengths from a few centimeters to 0.5 m. Wind was measured at a height of 16 m. In order to determine surfactant redistribution by an internal wave numerical computations were made of the Vaisala frequency profile, vertical structure of the modes of surface waves, their phase velocities and the field of horizontal velocity at the surface. Slick bands were situated approximately over IW troughs. The smoothing of ripples over the IW was calculated. In this observation scheme the kinematic effects of transformation of surface waves by an internal wave are insignificant. Future research will involve observation of the joint effect of both the kinematic and film mechanisms of manifestation of internal waves at the sea surface. Figures 2; references 11: 7 Russian, 4 Western.

UDC 551.35+551.46.08

Study of Local Inhomogeneities of Ferromanganese Nodule Deposits on Pacific Ocean Floor Using Self-Surfacing Samplers

907N0054A Moscow IZVESTIYA VYSSHIKH UCHEBNYKH ZAVEDENIY: GEOLOGIYA I RAZVEDKA in Russian No 11, Nov 89 (bx;1pp 74-85

[Article by Ye. A. Kontar, I. O. Murdmaa, N. S. Skornyakova and I. I. Soltanovskiy, Oceanology Institute imeni P. P. Shirshov, USSR Academy of Sciences]

[Abstract] Self-surfacing samplers can be used effectively in a detailed study of the local variability of fields of ferromanganese nodules (FMN) on the ocean floor. Use of reconnaissance surveys with such samplers can fill the gap between the detailed studies of the floor made by photography and more extensive, traditional larger-scale surveys. Samples were collected on profiles of 5-10 points with a length of 3-5 km, oriented across the strike of the slopes of the principal morphostructures. This makes it possible, with an accuracy not less than several hundred meters, to trace FMN ore deposits and to define their boundaries, to clarify the patterns of change in productivity and composition as a function of bottom morphology and the character of ambient sedimentation. Not only does the use of self- surfacing samplers result in a substantial saving of time and equipment, but also increases the quality of the collected geological information, with more reliable referencing to bottom

relief and with allowance for the dynamics of rising of the self-surfacing sampler. The results of running of 8 profiles in two test ranges revealed that deposits of nodules of the diagenetic type are associated with the relatively gentle slopes of swells and the accompanying depressions. Figures 4; references 12: 4 Russian, 8 Western.

UDC 550.831.001/017:551.46

Marine Geology and Geophysics: Study of Geological Structure of Ocean Floor by Satellite Geophysics Methods

907N0055A Moscow MORSKAYA GEOLOGIYA I GEOFIZIKA: IZUCHENIYE GEOLOGICHESKOGO STROYENIYA DNA OKEANA METODAMI SPUTNIKOY GEOFIZIKI in Russian 1989 pp 1-53

[Monograph by L. D. Nemtsev, G. V. Dementyev and Ye. G. Mirlin, All-Union Scientific Research Institute of Economics of Mineral Raw Materials and Geological Prospecting Work, USSR Geology Ministry, VIEMS Printery, 524 copies, 53 pages]

[Abstract] This is a review of existing and promising methods for making surveys from artificial earth satellites which are used or in the near future may be used in a geological study of the ocean floor. The brochure consists of an introduction, an outline of the principal methods for satellite geophysical measurements used in marine geology, a solution for the direct problem of potential theory and methods for computing geoid anomalies from geological models (geoid anomalies and anomalous gravity field potential; expressions for potential and geoid anomalies for very simple bodies; approximate methods for determining geoid anomalies for geological models of arbitrary configuration), and also a description of the principal results of satellite altimetric research and satellite magnetometric investigations. The possibilities for using such methods for the study of rift structures, submarine volcanoes, transformed faults, trenches and similar geological features are examined. The materials used in preparation of the brochure are overwhelmingly non-Soviet. Figures 18; references 46: 6 Russian, 40 Western.

UDC 551.596.9

Acoustic Instability of Currents With Circular Streamlines

907N0056A Moscow AKUSTICHESKIY ZHURNAL in Russian Vol 35 No 6, Nov-Dec 89 (manuscript received 21 Dec 88) pp 1059-1065

[Article by S. D. Danilov, Atmospheric Physics Institute, USSR Academy of Sciences]

[Abstract] In the first part of this research on the acoustic instability of a current with circular streamlines it is shown in the example of a Kelvin eddy that a small disturbance of the profile of current vorticity such that

the resultant profiles of vorticity and angular velocity decrease monotonically results in time-decreasing solutions of the initial problem of excitation of a disturbed current. A small vorticity disturbance evidently always exists, due to the diffusion of vorticity, if for no other reason. The results obtained for a Kelvin eddy with a disturbed profile can be generalized and it is shown that weak compressibility can induce acoustic instability only in those hydrodynamically stable currents with nonincreasing vorticity profiles which have neutral modes of oscillations or have profiles with a constant angular velocity. Such currents allow the existence of nonattenuating wave disturbances under incompressible conditions. Small vorticity profile disturbances, leading to monotonically decreasing distributions of vorticity and angular velocity, remove currents from this class. Slight compressibility does not result in acoustic instability in the case of adequately small Mach numbers. References: 5 Russian.

UDC 534.2

Sound Radiation by Shell With Longitudinal Stiffeners

[Article by V. N. Yevseyev]

[Abstract] Solutions are already available for the problem of sound radiation by an infinite plate and a cylindrical shell reinforced by a periodic system or a double periodic system of transverse stiffeners. In such problems the possibility of obtaining a solution in a closed form is governed by an infinite periodic series of stiffeners, each of which is exposed to identical conditions. However, there are other constructions in which periodicity is ensured by a finite number of reinforcing elements, solutions for which have not been found. Accordingly, a solution was obtained for the problem of sound radiation by a circular cylindrical shell, reinforced by stiffeners situated along the generatrix. The results of numerical computations and an analysis of the solution are given. It is shown that at resonance frequencies sound radiation is governed for the most part by low-order forms of oscillations in a circular direction (n = 0, 1, 2), whereas vibration is determined by higher-order forms of shell oscillations. Figures 4; references 7: 5 Russian, 2 Western.

UDC 551.463.21

Computation of Noise Directionality in Shallow Sea

[Article by Ye. P. Kuznetsova, Acoustics Institute imeni N. N. Andreyev, USSR Academy of Sciences]

[Abstract] Experimental data on high-frequency noise published by M. J. Buckingham, et al. ("A New Shallow Ocean Technique for Determining the Critical Angle of the Seabed From the Vertical Directionality of Ambient Noise in the Water Column," J. ACOUST. SOC. AMER., Vol 81, No 4, pp 938-941, 1987), taking into account attenuation in the bottom, absorption in sea water and scattering at the wave-covered ocean surface, were used as the source materials for this article. The basis for the model used with these data is an approach proposed by A. G. Voronovich in AKUST. ZHURN., Vol 33, No 1, pp 19-31, 1987 for description of noise in a near-surface waveguide; it is based on an expansion of the sound field in plane waves. In the model it is assumed as a simplification that the speed of sound in the considered area is constant and not dependent on coordinates; the ocean floor is even; the upper boundary of the ocean is wave covered. The mentioned data and model were used in computing the angular directionality of high-frequency noise generated by surface sources in a shallow sea. Experimental and computed data are compared and discrepancies are resolved. It was possible to define the linear dimension of the region meeting the requirement of horizontal statistical homogeneity of noise sources. A formula is derived for determining the extent of the region of horizontal statistical homogeneity. It is shown that the noise energy is collected in a region with a radius 150 km. Figures 3; references 5: 4 Russian, 1 Western.

UDC 551.501.796

Frequency Spectrum of Echo Signal Amplitude Fluctuations in Acoustic Sounding of Atmosphere

[Article by N. S. Time and Ye. A. Shur in, Atmospheric Physics Institute, USSR Academy of Sciences]

[Abstract] A study was made of the correspondence between the energy spectrum of a signal really registered at the outputs of a sodar and the spectrum of a scattered acoustic field registered by a sodar array. Spectral distortions caused by echo signal filtering and the "superposition of frequencies" effect were analyzed. Model computations were made of the influence of specific parameters of the apparatus on distortion of the a priori power spectrum. Experimental spectra of echo signal amplitudes obtained from altitudes of 48 and 65 m under conditions of well-developed convection are illustrated and on the basis of their comparison with the computed distorted model spectra it was possible to estimate the exponent of the initial spectrum of the amplitude of the scattered acoustic field: -0.81- -0.83. Figures 5; references 8: 6 Russian, 2 Western.

UDC 551.593

Computation of Refraction Angles on Basis of Model of Homogeneous Atmosphere

[Article by V. P. Nelyubina and N. F. Nelyubin, Atmospheric Optics Institute, Siberian Department, USSR Academy of Sciences, Tomsk]

[Abstract] Within the framework of a spherically symmetric atmosphere simple rigorous formulas were derived for computing the angles of refraction at great altitudes (greater than 60 km) on slant paths of arbitrary length. The merit of the derived formulas is their high accuracy and simplicity of use, not requiring support by aerological measurements. These formulas make it easy to take into account the additional influence of horizontal gradients of the refractive index on refraction in the vertical plane. The accuracy of the values of the refraction angles will be dependent on the errors in measuring astronomical refraction and the surface index or the meteorological parameters determining it. References: 8 Russian.

UDC 291.35.23

Interpretation of Surface Radiometric Measurements in Region 0.8- 1.35 cm With Parametrization of Systematic Errors

[Article by V. V. Rozanov and V. S. Kostsov, Leningrad State University]

[Abstract] A simple parametrization in the form of linear functions of radiobrightness temperature, corresponding to the "mean" state of the atmosphere, is proposed for a number of components of the systematic error which regardless of the design features of a radiometer may occur in spectral-angular measurements of radiobrightness temperature of descending radiation in the wavelength range 0.8-1.35 cm. On the basis of numerical experiments and the results of processing of in situ microwave-radiometer measurements a study was made of the effectiveness of use of the proposed approach in order to exclude the influence of systematic errors of the considered type. It is demonstrated, in particular, that the method makes it possible to obtain a solution of the essentially nonlinear inverse problem of humidity sounding without use of special iteration algorithms. The method makes possible effective suppression of the errors caused by nonlinearity, presence of a space background and calibration errors. Figures 3; references: 9 Russian.

UDC 551.510+551.501.7

Possibilities of Multisided Research on Atmospheric Boundary Layer by Remote Methods

[Article by Yu. F. Arshinov, B. D. Belan, S. M. Bobrovnikov, N. P. Krasnenko, I. A. Razenkov and M. G. Fursov, Atmospheric Optics Institute, Siberian Department, USSR Academy of Sciences, Tomsk]

[Abstract] The results of multisided experimental research on the atmospheric boundary layer, carried out using a Raman scattering lidar, aerosol lidar, acoustic sounder and aircraft laboratory are presented. The interrelationship of vertical distributions of temperature, humidity and aerosol is examined. The auto- and cross-correlation coefficients of the pertinent parameters are given. The results illustrate the capabilities of remote sounding apparatus and demonstrate the advantages of a multisided approach to research on meteorological and optical parameters of the atmospheric boundary layer. In the future this will make it possible to proceed to research on the boundary layer with a substantially greater spatial and temporal resolution than is possible

when using data from ordinary meteorological measurements. Figures 5; references: 6 Russian.

UDC 535.31:522.2

Measurement of Wave Front Dispersion Using Speckle Structure Statistics

[Article by A. V. Ivonin and L. A. Pushnoy, Atmospheric Optics Institute, Siberian Department, USSR Academy of Sciences; "Optika" Scientific Production Special Design Bureau, Tomsk]

[Abstract] The procedures of speckle optics are examined as applicable to determination of the quality of an optical system by wave front analysis. An improved method is proposed for measuring wave front dispersion. The optimal range of measurements, in which a highly acceptable accuracy is ensured, is determined. Use of the properties of Gaussian statistics and the assumption of nondependence of scattering particles and phase inhomogeneities made it possible to derive simple expressions for the correlation and dispersion of intensity registered in Fourier speckles. A diagram of the experiment for measuring the dispersion of the wave front by the optical components is given and serves as a basis for its detailed description. The merits of the method include good immunity to vibrations and simplicity in automation of measurements. The method can be used in developing optical elements, such as microobjectives and lenses, measuring high-frequency ripples of large mirrors and in investigations of atmospheric turbulence where rain and snow serve as a random amplitude screen. Figures 2; references: 10 Russian.

UDC 551.501:628.78

Experience in Remote Monitoring of Black and Mediterranean Seas in Optical Spectral Range

[Article by G. A. Grishin and V. F. Shermazan, Marine Hydrophysics Institute, Ukrainian Academy of Sciences, Sevastopol]

[Abstract] The scientific and methodological principles for organizing and conducting regional remote monitoring of hydrophysical fields in the Black and Mediterranean Seas employed at the Marine Hydrophysics Institute in 1987-1988 are examined. The principal monitorable hydrophysical fields and technical apparatus for the reception and processing of the registered data are listed in a table and discussed in the text. The following practical results can be expected when quantitative information is available on sea surface temperature, cloud cover, surface wind, frontal zones and sea

currents: assurance that hydrometeorological centers will have data on the temperature and dynamic regimes of the sea; improvement in short-range weather forecasts; collection of systematized data on structure and evolution of the upper quasihomogeneous layer; solution of the problem of genesis of general circulation in the Black Sea. The experience gained along these lines can be used in hydrophysical monitoring in other regions of the country. The range of parameters to be monitored, interval between surveys, processing and dissemination methods and total costs will be governed by the specific problems to be solved. Figure 1; references 5: 4 Russian, 1 Western.

UDC 551.466.31(262.5)

Experimental Research on Evolution of Wind Waves on Nonuniform Currents

[Article by S. A. Grodskiy, V. A. Dulov, V. N. Kudryavtsev and O. V. Shulgin, Marine Hydrophysics Institute, Ukrainian Academy of Sciences, Sevastopol]

[Abstract] This article gives the results of an aerial experiment for studying the spatial variability of the parameters of wind waves on nonuniform currents under conditions of a quasiuniform wind field. The work was done in the western part of the Black Sea distant from the shore during the summer and autumn of 1987 and 1988. The aircraft flew around a test range measuring 80 x 80 miles for a period of several hours. The sea surface was photographed at the points of intersection of a square grid with a 10-mile interval. During these same periods research was carried out by the research ship "Professor Kolesnikov." A calibration curve was constructed on the basis of the results obtained in the joint experiment. Measurements of the radar backscattering section made it possible to estimate the mean velocity of the near-water wind and the degree of its uniformity over the test range area. It was found that the influence of currents can be discriminated when there are quasihomogeneous wave-generating factors in the fields of integral characteristics of the two-dimensional spectrum of wind waves. The spatial variability of these fields with respect to the amplitudes of variations and with respect to structural characteristics does not contradict the refraction equations for waves on currents. Figures 4; references 6: 3 Russian, 3 Western.

UDC 551.521.32

Estimation of Atmospheric Counterradiation Over Ocean Based on Computations and Measurements

[Article by I. N. Plakhina, Yu. A. Volkov, A. S. Ginzburg and V. N. Gulkov, Atmospheric Physics Institute, USSR Academy of Sciences]

[Abstract] Data are given on descending atmospheric radiation (40 around-the-clock records) which were registered in February-March 1987 on the 38th cruise of the "Akademik Vernadskiy" in the eastern part of the Tropical Atlantic Energy-Active Zone using a special pyrgeometer developed at the Leningrad Electrotechnical Institute. Computations of descending radiation are presented for the corresponding meteorological conditions using different parametric schemes, followed by a comparison of the computed and experimental values of the considered long-wave radiation fluxes. The discrepancy in the results between measurements and computations for mean monthly values is 3-5

and for mean diurnal values is 8-10%. The emissivity of the ocean surface, estimated using data on effective radiation, averages $\delta = 0.96$. Figures 2; references 9: 7 Russian, 2 Western.

UDC 528.022.2.061.2-551.510.61

Geodesy. Theory and Practice of Adjustment Computations

doctor of technical sciences, and S. N. Zakroyshchikov, graduate student, Moscow Order of Lenin Institute of Geodetic, Aerial Photographic and Cartographic Engineers]

[Abstract] Some instrumental methods for determining the refractive index of air in interference measurements of distances are compared. As a convenience in comparison of the different methods the numerical computations were made for an identical distance (24 m). The principal requirements on these methods are outlined. There are substantial difficulties in application of all these methods which are attributable to the high accuracies required. It is shown that a high interference accuracy in actuality is not difficult to achieve, but a method would be preferable which could be used with existing industrially produced interferometers without any remodeling. Two methods can be recommended for further development: 1) an absolute method with use of a vacuum chamber and 2) a method for registry of the refractive index by an auxiliary moving interferometer integrated in a single module with a remote reflector. Figures 3: references 8: 6 Russian, 2 Western.

UDC 528.7:550.837.82

Linear Regression Methods in Remote Sensing

[Article by Yu. A. Ilin, docent, candidate of technical sciences, Moscow Order of Lenin Institute of Geodetic, Aerial Photographic and Cartographic Engineers]

[Abstract] A transformation to one- and multiparameter linear regression relations is analyzed in the example of problems of remote determination of parameters of the underlying surface. It is shown that regression methods are a first approximation in quantitative analysis of the state of geosystems and the response function can be approximated by a linear regression relation with the sought-for parameter under the condition of a constancy of the sensing system parameters and a weak dependence of the response function on the other parameters of the investigated geosystem. A method for remote determination of the refractive index and the refraction of the atmospheric surface layer is proposed on the basis of a number of linear regression equations relating the parameters of the atmosphere and ocean. References 7: 4 Russian, 3 Western.

UDC 551.521.3+535.361

Theory of Linear Vision Systems: Modeling of Linear System Characteristics

[Article by V. V. Belov, Atmospheric Optics Institute, Tomsk]

[Abstract] Approaches to solution of problems in the theory of vision are examined. A critical review is given (a bibliography of 55 Soviet and foreign sources is cited) of the various methods for measuring and computing the characteristics of linear systems describing the process of transfer of an image through scattering media. Various aspects of application of the Monte Carlo method in problems of vision through scattering media are discussed. An interpretation of some experimentally observed regularities in distortions of images by such media is proposed. Figures 4; references 55: 36 Russian, 19 Western.

UDC 551.510.42

Optical Methods in Research on Atmospheric Boundary Layer Dynamics

[Article by I. E. Naats, Atmospheric Optics Institute, Siberian Department, USSR Academy of Sciences, Tomsk]

[Abstract] The principles of the theory of optical monitoring of the atmospheric boundary layer are outlined as applicable for routine remote monitoring of its dynamic characteristics and subsequent solution of ecological problems, such as predicting the transport of pollutants. Emphasis is on methods for solving the problems in atmospheric optics involved in retrieving the field of coefficients of the turbulent diffusion of aerosols on the

basis of laser sounding using data on aerosol light scattering. The structure of a decision algorithm is given for determining the spatial-temporal variability of the field of microstructure of aerosols from optical measurements and studying the physical processes in which aerosols play a role under real atmospheric conditions. References 10: 9 Russian, 1 Western.

Tomographic Sounding Method in Atmospheric Research by Lidar

[Article by V. V. Veretennikov, Atmospheric Optics Institute, Siberian Department, USSR Academy of Sciences, Tomsk]

[Abstract] An increase in the effectiveness of use of lidar systems carried aboard aircraft is possible when processing measurement data using reconstructive tomography methods, such as proposed by D. C. Wolfe, et al. in APPL. OPT. Vol 21, No 7, p 1165, 1982. It is assumed that a lidar is mounted on a platform moving linearly at a given altitude above the surface and sounding is carried out in the direction of the lower hemisphere. The objects of research are the spatially inhomogeneous fields of optical characteristics (attenuation and scattering coefficients). A tomographic sounding scheme is proposed and an algorithm is described for the interpretation of lidar signals with application of the computational tomography principle. The immunity of the algorithm to errors in initial data are discussed. The results of solution of model problems are presented. Figures 3; references 9: 4 Russian, 5 Western.

Errors in Lidar Measurements of Atmospheric Extinction Index With Change in Scattering Phase Function

[Article by G. N. Baldenkov, V. I. Kozintsev and Ye. E. Mozharov]

[Abstract] An analysis was made of the results of model computations of the errors in measuring the mean atmospheric extinction index due to inconstancy of the indicatrix g_π in the case of presence of a cloud on the sounding path (all computations were made applicable to the "Elektronika-03" lidar for sounding angles up to 15° to the horizon). Three methods for registry of the path along which the mean extinction index is measured are examined. It is demonstrated that with respect to minimizing the mentioned errors the integral method with registry of path length on the basis of dropoff of the

backscattering signal by a stipulated number of times is preferable. Figures 4; references 7: 6 Russian, 1 Western.

Solution of Sounding Problem on Basis of Quantitative Description of LP-Lidar

[Article by A. M. Khazanov, G. A. Koganov and Ye. P. Gordov, Computation Center Section, Far Eastern Department, USSR Academy of Sciences, Komsomolsk-na-Amure; Atmospheric Optics Institute, Siberian Department, USSR Academy of Sciences, Tomsk]

[Abstract] A solution of the problem of laser coherent sounding of the atmosphere is given on the basis of a quantitative model of an LP lidar. A mathematical model is constructed which makes it possible to obtain an adequate quantitative description of an LP lidar. Programs are written which make it possible to process the experimental results in a dialogue regime and also to organize a database effective for different measurement ranges. The proposed reception method is highly promising for atmospheric sounding because it imposes no serious restrictions on ordinary heterodyne reception. It also has a far greater noise immunity in comparison with the classical method for sounding with a photodetector because it has a narrow amplification band, making it possible to work at any time of day and in any season of the year in both the visible and infrared spectral regions. Figures 3; references 9: 8 Russian, 1 Western.

Image Retrieval From Incomplete Information on Spatial Spectrum in Multiaperture System

[Article by P. A. Bakut, V. V. Milovzorov, A. A. Pakhomov and A. D. Ryakhin]

[Abstract] An improved method is proposed for retrieving the image of an object in a linear multiaperture optical system (MOS). Many such MOS have been developed in recent years which are intended for the spatial synthesis of apertures with an equivalent diameter greater than 10 m. Due to the finite number and limited size of the telescopes making up the MOS information on the Fourier spectrum of he object can be obtained only in individual sectors of the synthesized frequency region. In this case the processing problem is much more complex and for retrieving images it is necessary to extend the determined spectral evaluations to the entire range of spatial frequencies. A first stage in solution of this problem is outlined. The results of modeling of the retrieval process are given for a case

when information on the spectrum, or only on the spectral components, is known in a "cross," the width of whose sides D/λ (λ is wavelength) is substantially less than their length L/λ. This situation may arise, for example, when using a linear MOS consisting of telescopes with a diameter D with a maximal spacing distance L of images in two mutually perpendicular directions. Expressions are derived for the number of independent readings of the spectrum of the object (its modulus, phase) which ensures a satisfactory quality of image retrieval with different signal-to-noise ratios in the initial data. Figure 1; references 9: 6 Russian, 3 Western.

UDC 551.501

Method for Retrieving Atmospheric Optical Thickness Using Data From Multiangle Laser Sounding

[Article by K. I. Gobrusenko and B. P. Ivanenko, Atmospheric Optics Institute, Siberian Department, USSR Academy of Sciences, Tomsk]

[Abstract] A multiangle sounding method, in combination with the regularizing algorithm of the logarithmic derivative method (B. P. Ivanenko, et al., Izv. AN SSSR: FAO, Vol 19, No 1, pp 94-98, 1983), was used in retrieving the optical thickness of the atmosphere or the lower boundary of dense cloud formations. The principles of the combined method are explained. The algorithm was tested in the processing of data from real laser sounding of cloud formations. Soundings were carried out in the Crimean Oblast in October 1988. Computations were made using a microcomputer and a set of programs suitable for the interpretation of laser sounding data registered in single- and multifrequency and multiangle atmospheric sounding. The proposed method is quite efficient and noise immune and can be used in routine processing of radar signals. Figures 3; references 6: 3 Russian, 3 Western.

UDC 551.521.3

Analysis of Quantitative Data on Tropospheric and Stratospheric Aerosol Attenuation Index in Subsatellite Experiment

[Article by V. S. Maksimov and S. V. Tatyanin]

[Abstract] The results of direct spectronephelometric measurements of the aerosol attenuation index $\mu_a(\lambda)$ in the spectral region 0.38-1.02 μm from aboard an aircraft laboratory at altitudes from 0 to 5 km are presented for the background conditions prevailing in the central part of the European USSR. The results are compared with data obtained by synchronous sounding from a spacecraft under the SAGE program, in which regular investigations of stratospheric and tropospheric aerosol are carried out by the method of retrieval of the vertical profile of the attenuation index. A comparison of the results revealed that the vertical profiles $\mu_a(\lambda,H)$ and the values of the Angstrom index, measured by different methods, satisfactorily coincide, supplementing one another vertically. This is evidence of the technically attainable possibility of carrying out modern multisided optical research in the entire thickness of the atmosphere with the necessary degree of spatial resolution, reliability and accuracy. Figures 2; references 8: 6 Russian, 2 Western.

UDC 551.521

Structure of Field of Reflected Solar Radiation in Visible Part of Spectrum Using Data From 'Intercosmos-21' Artificial Earth Satellite

[Article by Sh. A. Akhmedov, Space Research Scientific Production Association, Baku]

[Abstract] Variations of the spectral brightness of the "surface- atmosphere" system are quite significant even when the atmosphere is highly transparent and statistical methods must be used in studying the spectral structure of the field of solar radiation. The article describes some possibilities in this direction when using data from measurements of spectral brightness in the range 0.415-0.822 μm made by the "Intercosmos-21" satellite using microwave apparatus. The spectra of reflected solar radiation over some sectors of Azerbaijan and Georgia, over Krasnoyarsk Kray and the Pacific Ocean, were processed. In all the investigated regions the first three eigenvectors are adequate for revealing the principal patterns of distribution of radiation fluxes in the spectrum and for ensuring representation of the measured brightness spectra with an error 15-20%; when the first five eigenvectors are used the error is reduced to 7-10%. Figures 2; references: 3 Russian.

UDC 551.510.42:551.521.31

Estimation of Atmospheric Aerosol Optical Thickness Based on Data From Surface and Shipboard Actinometric Measurements

[Article by G. M. Abakumova, candidate of geographical sciences, and I. N. Plakina and T. A. Tarasova, candidates of physical and mathematical sciences; Moscow State University; Atmospheric Physics Institute]

[Abstract] A comparison was made of different methods for estimating aerosol optical thickness on the basis of data from surface measurements of direct solar radiation (S) in order to ascertain how closely they are in agreement and which can be best used in making actinometric observations at sea and over the land. First method: determination of spectral aerosol optical thickness (SAOT) from the spectrum of aerosol and molecular attenuation and absorption of radiation by water vapor. Second, an approximate method for determining the SAOT from S. Third, computation of direct solar radiation in the spectral region 0.38-0.71 μm (photosynthetically active radiation), where absorption by water vapor is absent. Fourth, approximate methods for estimating SAOT from solar radiation measurements in the spectral regions: 0.525-0.63 and 0.38-0.71 μm. Fifth, use of empirical regression relations. Sixth, using the relation between total aerosol optical thickness and SAOT. All these methods were tested under marine and continental conditions. The first and second methods give very close results. Computations using wide-band light filters outside the water vapor absorption bands are simpler and do not require estimates of the contribution of water vapor absorption but may have an additional experimental error. Methods 3 and 4 can be used effectively in making computations on the basis of photosynthetically active radiation. SAOT values can be obtained on the basis of spectral measurements of solar radiation using spectrometers and narrow-band light filters. Figures 3; references 15: 13 Russian, 2 Western.

Numerical Approximation of Wind-Wave Interaction Parameter

[Article by V. K. Makin, candidate of physical and mathematical sciences, Leningrad Section, Oceanology Institute]

[Abstract] Experimental estimates and numerical computations show that the overwhelming contribution to the β (wind-wave interaction) parameter is from pressure forces β_p. An experimental determination of the flow involves great technical difficulties which arise due to the need for measuring the fluctuating pressure field near the instantaneous wave surface and these difficulties have not yet been overcome. The most detailed and complete computations of the energy flows to unidirectional waves have been made on the basis of a spectral model of the near-water layer developed in an earlier article by the author (MORSKOY GIDROFIZICHESKOY ZHURNAL, No 2, 1988). On the basis of this model the article gives computations for the ranges of the wave development parameter 0-8 and the drag coefficient 10^{-3}-3×10^{-3}. The findings are used in constructing a two-parameter approximation of the β

parameter which is recommended for use in model predictions of waves. Figure 1; references 9: 5 Russian, 4 Western.

Measurement of Fluctuation Parameters of Radar Signal Scattered by Sea Surface

[Article by O. Yu. Lavrova and A. D. Rozenberg, Space Research Institute, USSR Academy of Sciences, Oceanology Institute, USSR Academy of Sciences]

[Abstract] The article gives the results of joint measurements of radar signals and sea waves carried out from a drifting ship in the open ocean. The measurements were made in the summer of 1983 in the tropical zone of the Atlantic and Pacific Oceans on the sixth cruise of the "Akademik Keldysh." The sea surface was irradiated by the "Okean" shipboard radar. Data are given for the mean and fluctuating powers of signals at wavelengths 3 and 10 cm and for horizontal polarization of radiation, for small glancing angles and for different directions of irradiation in the horizontal plane. A modified modulation function, determined by the ratio of the power spectra of the scattered signal and slopes of the energy-bearing components of sea waves, was examined. A different nature of the influence of the wind and long waves on the characteristics of scattered signals is observed. The modulation of the signal by long waves is caused by purely hydrodynamic effects due to the influence exerted on ripples by the orbital velocity of long waves and different wave-generation conditions along a long wave and also occurs due to a change in the local angle of irradiation of different elements of long waves in the vertical plane. The variability of the signal determined by these factors increases with a decrease in the glancing angle and has a distinct anisotropy in the horizontal plane caused by the narrow angular spectrum of long waves. The wind is a destabilizing factor reducing modulation by long waves due to such effects as the incoherence of scattering ripples, presence of foam and spray. Figures 4; references 12: 5 Russian, 7 Western.

Isoplanarity in Vision Systems

[Article by V. V. Belov, G. M. Krekov and I. Yu. Makushkina, Atmospheric Optics Institute, Siberian Department, USSR Academy of Sciences, Tomsk]

[Abstract] A criterion is proposed and the results of evaluation of the size of the central isozone are presented

for a vertical observation scheme. A study was made of their dependence on the optical and geometrical parameters of the employed vision system. The computations were made in the single scattering approximation and (with allowance for multiple scattering) by the Monte Carlo method. Within the framework of the considered criteria the size of the zone of isoplanarity is a complex, unambiguous function of the optical and geometrical parameters of the image (such as optical thickness and scattering phase function). The Monte Carlo method was used in obtaining quantitative estimates of the central isozone for specific situations. However, the complex nature of certain interrelationships does not make possible reliable extrapolation of the estimates to other observation conditions in the case of small optical thicknesses and when there are layers of increased turbidity in the medium. These facts must be taken into account when using a single point blurring function for the reconstruction of images obtained when registering the angular distribution of brightness at a single fixed point in space or when the image is formed by a system of the aperture angle type when angular scanning is carried out in one coordinate but movement of the receiver itself occurs in another coordinate. Figures 6; references: 10 Russian.

UDC 535.36

Determination of Absorption Index in Layers of Slightly Absorbing Disperse Medium of Arbitrary Optical Thickness

[Article by A. P. Ivanov, V. A. Loyko and V. V. Berdnik, Physics Institute, Belorussian Academy of Sciences, Minsk]

[Abstract] In an analysis of the absorption characteristics of various disperse media, such as atmospheric aerosol precipitated on a backing, the layer cannot always be considered optically thick and traditional methods cannot be considered acceptable. Accordingly, a method was devised for determining the absorption index of a disperse medium which is free of the requirement of a great optical thickness of the layer. Formulas are derived for the absorption index on the basis of the measured reflection and transmission coefficients of layers of finite thickness. Two methods are proposed for determining weak absorption. For application of the first it is sufficient to have one sample of finite thickness, whereas for the second two are required: with finite and infinitely great thicknesses. It is shown that the minimal errors attained in both methods are close. However, the second method makes it possible to determine the absorption index with an error differing little from the minimal error in a wider range of thicknesses than the first. Figures 4; references: 10 Russian.

UDC 621.375.826:551.5

Molecular Absorption of Radiation by Water Vapor in Atmospheric Relative Transparency Window 8-13m

[Article by V. N. Arefyev, Tayfun Scientific Production Association, Moscow]

[Abstract] In situ and laboratory investigations of molecular absorption of radiation by water vapor in the window of relative atmospheric transparency 8-13μm, covering a broad range of change in parameters (total and partial pressure, temperature, humidity, range of visibility, wavelength) exerting an influence on absorption are reviewed. This research has confirmed and refined the basic behavior and parameters of continuum and selective absorption. The results have made it possible to construct an improved semiempirical model of the continuum. Computations made using this model are consistent with the specific results of other studies. Comparison of computations with the results of in situ experiments confirmed the important role of the continuum in the attenuation of radiation in the window 8-13μm. In the case of laser radiation an important role is frequently played by selective absorption. The spectroscopic parameters of a number of absorption lines of water vapor, overlapping with the generation lines of a CO_2 laser, were determined as a result of the measurements. Figures 14; references 64: 33 Russian, 31 Western.

UDC 621.373.82

Incidental Four-Wave Interaction Under Conditions of Strong Wave Energy Exchange

[Article by A. N. Sukhorukov, V. N. Titov and V. A. Trofimov, Moscow State University imeni M. V. Lomonosov]

[Abstract] The incidental interaction of four hyper-Gaussian and Gaussian beams was investigated applicable to the wave front inversion problem. In contrast to earlier studies, this article examines the case of strong energy exchange of waves when traditional analytical methods are unsuited for an adequate description of the processes involved. Numerical simulation was used. A comparison of the results obtained both on the basis of approximation of a preset field and with allowance for the energy exchange of pumping waves was also made. It was found that with an increase in the length of collinear interaction, due to the self-effect of the beams, mutual energy transfer (even for hyper-Gaussian beams with m = 10) has an oscillating character. The amplitude of the

oscillations and their period are determined by the initial profile of the beams. Similar dependencies are observed for the wave front inversion quality test. The quality of the inversion, especially for Gaussian beams, is increased if the wave interaction occurs noncollinearly. Figures 3; references: 7 Russian.

UDC 551.510.42

Inverse Problems in Light Scattering by Aerosol Systems Interacting With Physical Fields

[Article by I. E. Naats, Atmospheric Optics Institute, Siberian Department, USSR Academy of Sciences]

[Abstract] Since optical methods do not disturb the investigated medium it is possible to obtain the most reliable information on parametric fields. The main difficulties in this approach are related to the inversion of optical measurements and the unambiguous extraction of physical information from them. This article describes the development of numerical methods for the interpretation of data from optical sounding of polydisperse systems of particles interacting with physical fields. An aerosol system in the humidity field is examined as the principal example since the interaction of aerosols with the humidity field plays an important role in the solution of prognostic problems related to the time of presence of dispersed pollutants in the atmosphere. The theory of inverse problems of the optics of an aerosol interacting with different physical fields in the atmosphere is used in exploring this phenomenon. It is shown that on the basis of a numerical solution it is possible to develop methods for the remote investigation of physical processes in the atmosphere and spatial-temporal variability of parametric fields. The initial information used is the aerosol characteristics of light scattering, measured using instruments for optical sounding of the atmosphere. The fundamental integral equations are given for the considered inverse problems and methods for their numerical solution are outlined. References 10: 9 Russian, 1 Western.

UDC 551.322:535.243

Laser Spectroscopy of Snow Cover and Glaciers

[Article by M. Ch. Zalikhanov, corresponding member, USSR Academy of Sciences, A. Yu. Bekkiyev, candidate of physical and mathematical sciences, S. M. Glushkov, A. M. Kerimov, I. M. Panchishin, V. V. Fadeyev, doctor of physical and mathematical sciences, and L. A. Ushakova, candidate of geographical sciences, Alpine Geophysical Institute; Moscow State University]

[Abstract] The first part of the article describes a laser fluorimetry method for determining snow cover parameters which makes possible remote determination of the pollution level in a given region. The second part is devoted to the development of laser methods for the analysis of snow cover parameters (moisture content, temperature) which in combination with other parameters of snow cover state are decisive characteristics on whose basis it is possible to predict avalanches and snow cover strength. The proposed method for monitoring the concentration of organic impurities can be used both at the surface at different times subsequent to a snowfall and in the depths of the snow in holes or fissures, making it possible to obtain information on processes at different time scales. Laboratory and field (Moscow, Caucasus, Antarctica) research demonstrated the feasibility and desirability of combining the fluorescent method for remote determination of organic impurities in the snow-ice cover and the laser Raman spectroscopy method for remote determination of snow moisture content. The laser method makes possible remote determination of snow moisture content in 1-2 minutes. The placement of laser apparatus aboard a vehicle makes it possible to survey an extensive area in a short time. Figures 3; references: 6 Russian.

UDC 551.596.1

Evaluation of Parameters of Surface Pulsed Source by Remote Acoustic Method

[Article by G. A. Bush, Ye. A. Ivanov, S. N. Kulichkov and N. V. Pedanov, Atmospheric Physics Institute, USSR Academy of Sciences; Earth Physics Institute, USSR Academy of Sciences]

[Abstract] A study was made of the possibility of use of a remote acoustic method for evaluating the parameters of an atmospheric wave near a source. The parameters used were acoustic energy E and the I value, representing the product of the atmospheric profile (in pressure- time coordinates) and distance to the source. The acoustic waves were registered at horizontal distances of several hundred kilometers from the surface sources. The signal reflection altitudes were in the upper stratosphere and lower thermosphere. The sound sources were industrial shots set off in the middle latitudes in winter and summer. The results of five experiments are given, demonstrating that the E and I parameters can be reliably determined. A more precise expression is derived for determining acoustic energy E which is different from that used traditionally. Figures 3; references 12: 8 Russian, 4 Western.

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Estimating Parameters of of Ground Pulse Source by Method of Remote Acoustic Sounding

[Article by G.A. Bush, Ye.A. Ivanov, S.N. Kulichkov, and M.V. Pedanov, Institute of Atmosphere Physics and Institute of Earth Physics, USSR Academy of Sciences]

[Abstract] Acoustic signals from industrial explosions on ground were recorded upon their reflections within the upper stratosphere and within the lower thermosphere, five such experiments having been performed with either two or three 4147 Bruel-Kjaer capacitive microphones at several points 40- 300 m apart and at horizontal distances of 200-650 km from the source. On the basis of the readings are estimated the acoustic energy E and the characteristic parameter I equal to the product of $f^{1/2}$ (f-focusing factor), distance r from the source, and time integral of pdt (p- recorded pressure). This parameter remains invariable during the sound propagation process, immune to nonlinear effects, when dissipation is not significant. Theoretical analysis of the data with calculations by the L.M. Brekhovskikh method and the $E_1 = kI^{3/2}$ relation for the initial signal according to K.Ye. Gubkin (E- acoustic energy in air wave) results in the acoustic energy $E(\tau)$ (τ- duration of one phase of a bipolar signal) and $E(p)$ being proportional to τ cubed and to p cubed respectively, assuming that the sound pulse is triangular while still near the source. Figures 3; tables 1; references 12.

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Possibility of Parametric Instability in Ocean and in Atmosphere

[Article by G.S. Dvoryaninov and R.A. Valentyuk, UkSSR Academy of Sciences and Maritime Institute of Hydrophysics]

[Abstract] Measurements with instruments mounted in numerous automati- cally controlled buoys were made during voyages on the Scientific Research vessels "Akademik Vernadskiy" and " Mikhail Lomonosov" covering the western part of the Middle Atlantic covering the Amazon bay and the Guyana shelf, also the Caribbean basin, for information about flow and temperature oscillations in the ocean and temperature oscillations in the atmosphere above. Readings were taken in sufficiently short intervals of time (1 h for parameters of the water, 3 h for the parameters of the air) over a sufficiently long period of time for reliable statistics and spectrum analysis by the maximum entropy method. Calculations based on the equation of internal waves for linearly dynamic nonviscous fluid, where W= ρw (ρ-density, w- velocity in vertical direction) and the Viaisiali-Brunt frequency squared N^2= -g(dρ/dz)/ρ (z- vertical coordinate) is a function of time and depth, lead to the Mathieu equation $d^2W'_0/ d\tau^2 + [a- 2q \cos 2\tau W'_0$ (W'-fluctuation component of vertical velocity, τ- phase of fluctuation component). The solution to this equation contain successive regions of dynamic instability in the a,-q plane which at parametric resonances give rise to internal gravitational waves corresponding especially to even harmonics of tidal and inertial oscillations. Other mechanisms of their excitation have been considered and the Coriolis force shown to play an important, particularly stabilizing, role in any process of their buildup. Figures 7; tables 4; references 15.

UDC 551.510.42

Scattering and Transport of Impurity in Upper Atmosphere

[Article by M.F. Lagutin, D.M. Smagin, and A.D. Pivenko, Kharkov Institute of Radioelectronics]

[Abstract] The behavior of an impurity cloud in both the mesosphere and the lower thermosphere is analyzed for interpretation of readings taken with highly sensitive lidar equipment, considering that movement of a cloud through these highly turbulent regions depends on the wind pattern. While the regular component of wind transports a cloud forward, its fluctuation component scatters and thus expands it. Scattering covers all stages from initial action involving microscale turbulence to final action involving the entire spectrum of developed turbulence. The analysis of scattering is based on the diffusion model, assuming a passive neutral one-component gas generated by a momentary point source. The characteristic time periods of three successive stages in the scattering process are identified in accordance with the Kolmogorov-Obukhov theory of developed turbulence: dissipation of eddy kinetic energy, inertial flow, and large-scale vortical flow. The role of attendant physical and chemical processes, particularly those resulting in an irreversible loss of mass (production of metal hydroxide, formation of ion clusters, adsorption by aerosol) is evaluated and added to the model. The effect of high meridional-zonal velocities of the regular wind component, reaching and exceeding 60 m/s, is also included in the comprehensive analysis. Figures 1; references 13.

Where Is the Ozone Going?

[Interview With USSR State Committee for Hydrometeorology Deputy Chairman V. Zakharov by correspondent A. Boldinyuk]

[Text] With the advent of autumn in the Northern Hemisphere reports on the ozone hole above Antarctica have once again begun appearing on the pages of the world's newspapers and journals. It is precisely in these months, when a short spring reigns in the southern latitudes, that depletion of the planet's protective ozone belt is observed. The ozone concentration at an altitude of 15-25 kilometers is practically zero. Since the time in 1985 when the English researcher G. Farman discovered this phenomenon, specialists have developed the rather stable opinion that the ozone hole arises in early September.

But now data obtained by scientists from the university in the state of Colorado, USA, have been published in the latest issue of the American journal NATURE. According to this communication, the ozone hole above Antarctica is forming almost a month earlier than "usual"—in mid- August. Our correspondent A. Boldinyuk asked USSR State Committee for Hydrometeorology Deputy Chairman V. Zakharov to comment on the communication from the USA.

[Zakharov] This year, formation of the ozone hole began in late August. This is confirmed by observations made by the Antarctic stations Mirnyy and Novolazarevskaya and by the results of satellite research on the ozone layer. This year the hole attained dimensions and rarefaction comparable with what we observed in 1987. Ozone disappeared over most of Antarctica then. But a year ago, in autumn 1988, formation of an ozone hole was practically not observed.

[Boldinyuk] In other words this is an almost unpredictable phenomenon?

[Zakharov] Yes, though the observations that have been made provide a possibility for concluding that formation of the ozone hole is closely related to development of a so-called circumpolar vortex. Inflow of ozone from the equator ceases with the beginning of the Antarctic spring. The quantity of ozone decreases toward the end of the polar night—sunbeams are necessary for its accumulation in the stratosphere, you see. And finally, with the beginning of the warming period, the reaction between atmospheric ozone and substances that destroy it—chlorofluorocarbons (Freons)—proceeds increasingly more actively. These substances are distributed throughout the entire atmosphere, but it is only above Antarctica that conditions permit Freons to enter into reactions.

[Boldinyuk] Do similar changes occur in the Northern Hemisphere?

[Zakharov] Luckily for us, the factors necessary for this do not exist here. Therefore although an overall reduction in the quantity of ozone above our latitudes is being recorded, it does not elicit apprehensions—the decrease is only a few percent. But development of this process must be studied in the most meticulous fashion, and everything possible must be done to reduce discharges of substances that destroy ozone. Everything in earth atmosphere is mutually related, and our knowledge of what occurs within it is still insufficient. By observing the ozone hole over Antarctica we obtain data on the condition of all atmospheric ozone.

[Boldinyuk] Is joint international research on the state of atmospheric ozone being conducted?

[Zakharov] We are cooperating with scientists from the USA, the GDR, Bulgaria and Mongolia. Major projects are now being conducted jointly with American researchers. For example the Soviet satellite Meteor-3, which will carry American instruments, will take measurements in the stratosphere. Launching of the satellite is planned in 1991. Memoranda on cooperation in research on the climate and on the Arctic Basin were signed this week during a visit by Canada's Prime Minister B. Mulroney.

[Boldinyuk] Vladimir Matveyevich, why in your opinion are scientists from different countries devoting so much attention to the problem of the ozone hole above Antarctica? Europe and North America seem so remote from that region.

[Zakharov] Were the ozone concentration in the atmosphere to decrease only above the South Pole, the problem would be only of narrow scientific interest. But the same thing is also occurring at moderate latitudes. The ozone hole is only a fragment of the big picture. Perhaps the clearest and most tangible. Antarctica models the situation, in a sense providing a possibility for studying it "in pure form." And further research on what is happening in this nook of the globe is an absolute necessity.

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